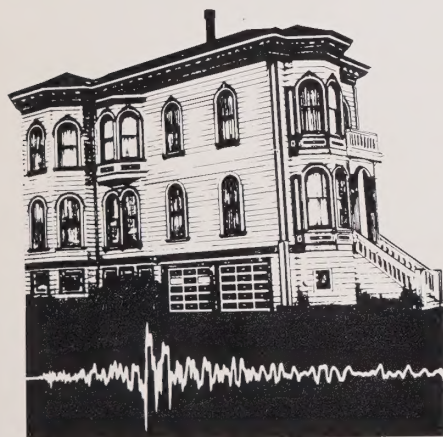
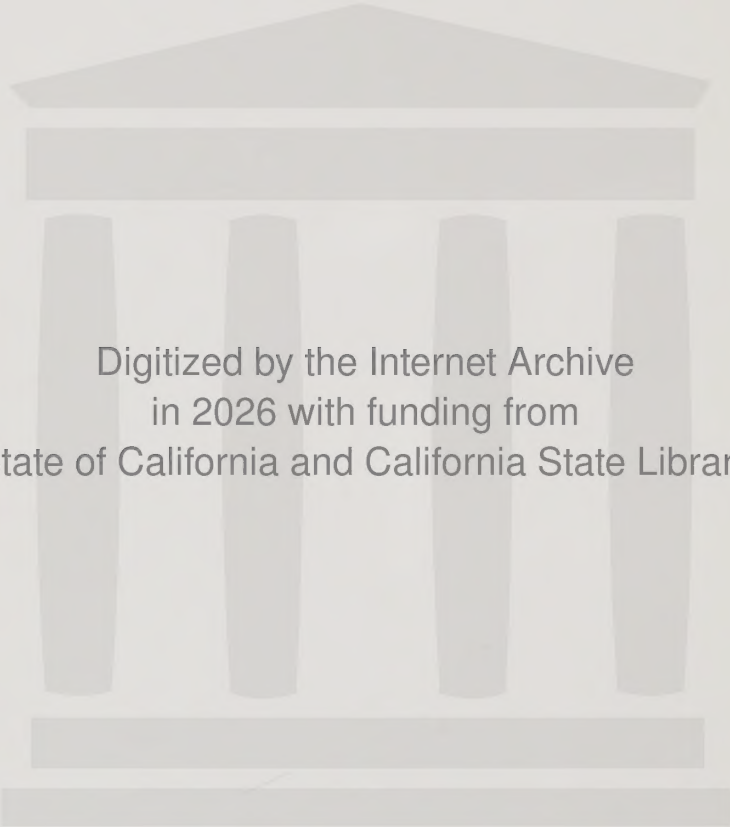


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HOME EARTHQUAKE PREPAREDNESS GUIDE





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HOME EARTHQUAKE PREPAREDNESS GUIDE

EQE Incorporated is an engineering/planning firm specializing in earthquake engineering for business and industry.

EQE engineers have visited and researched the effects of numerous earthquakes throughout the world. This guide is based on our experience.

The construction details and instructions for the home strengthening projects presented in this guide were contributed by EQE Construction, Inc. (a subsidiary of EQE Incorporated). EQE Construction specializes in strengthening of existing residential and commercial buildings to better withstand earthquakes.

While every reasonable effort has been undertaken to ensure the accuracy of this book, EQE Incorporated and its corporate sponsors assume no responsibility or liability of any kind for its accuracy or completeness or for additional or changed information subsequent to the date the materials contained herein were submitted for publication.

Reproduction of this guide was supported by joint funding through a cooperative agreement between the Federal Emergency Management Agency and the California Seismic Safety Commission (EMF 86-K-0253). The recommendations and suggestions included in this document are intended to improve earthquake preparedness, response and mitigation. The contents do not necessarily reflect the views and policies of the Federal Emergency Management Agency or the California Seismic Safety Commission and do not guarantee the safety of any individual, structure or facility in an earthquake situation. Neither the United States nor the State of California assumes liability for any injury, death or property damage which occurs in connection with an earthquake.

EQE Home Earthquake Preparedness Guide

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by Bay Area Regional Earthquake Preparedness Project (BAREPP)

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The diagrams, specifications, and instructions for projects included in this guide are for one- or two-story wood-frame residential structures.

Special notes are included in the instructions; be sure to read these notes to ensure the application will fit your situation. For information on situations other than those covered by this guide or for changes to the projects, we suggest that you contact a civil/structural engineer.

EARTHQUAKES IN CALIFORNIA

California is the highest earthquake risk area in the contiguous United States. Several large, well-known, active faults run through the state -- the San Andreas, Hayward, and Newport-Inglewood for example. They have been the cause of destructive earthquakes in the past and will be the sources of future destructive shocks.

Since the 1906 San Francisco earthquake (8.3 on the Richter scale), California has not experienced a major destructive quake with a magnitude greater than 8.0. Such earthquakes, therefore, can be characterized as low-probability, high-loss

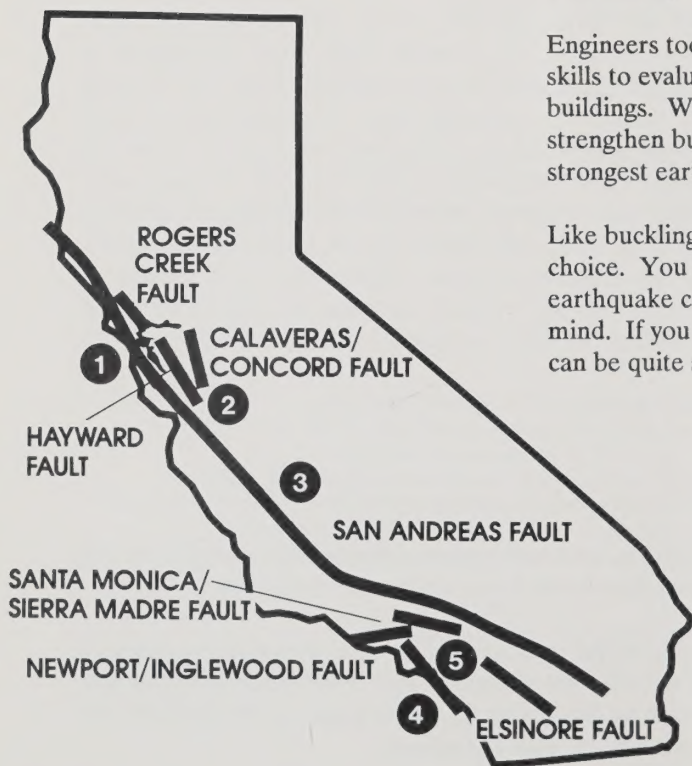
events. However, damaging earthquakes with magnitudes greater than 6.5 occur in California on the average of every four years.

Today we have a good understanding of earthquakes, their effects and their damage potential. We still are unable to predict when the next earthquake will occur. However, the effects of earthquakes on homes and buildings are predictable.

In the recent Morgan Hill and Coalinga earthquakes, the kinds of damage that affected homes in 1906 occurred again. This damage can be prevented.

Engineers today have the knowledge and skills to evaluate the risks to all types of buildings. We can also design and strengthen buildings to withstand the strongest earthquake.

Like buckling your seat belt, you have a choice. You can live and work in earthquake country and have peace of mind. If you take a few precautions, you can be quite safe.





1 1906 SAN FRANCISCO, 8.3 Richter Scale
Damage to homes built before earthquake codes.



2 1984 MORGAN HILL, 6.2 Richter Scale
Damage to newer homes improperly designed or constructed.



3 1983 COALINGA, 6.7 Richter Scale
Damage to older homes built before earthquake codes.



4 1933 LONG BEACH, 6.3 Richter Scale
Damage to homes built before earthquake codes.



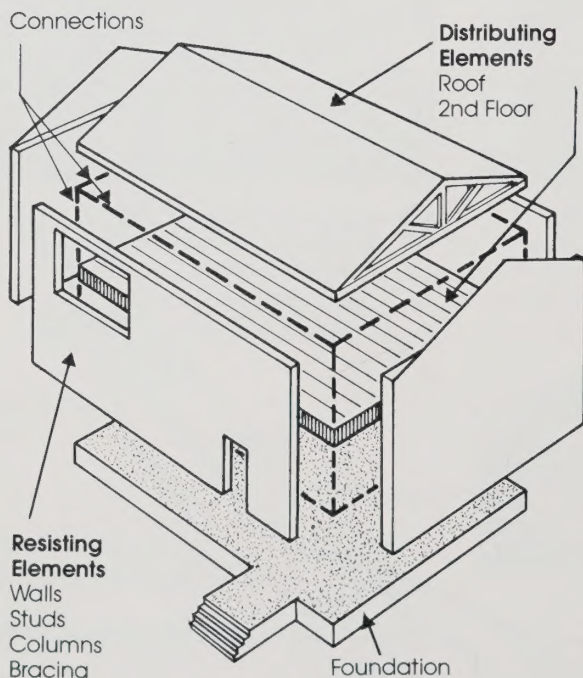
5 1971 SAN FERNANDO, 6.6 Richter Scale
Damage to newer homes improperly designed or constructed.

HOW SAFE IS YOUR HOME?

The basic square single-story, wood-frame house is one of the safest types of structures in an earthquake. The amount of damage incurred should be minimal if the house is properly engineered and built. The key to a well-designed building is its ability to withstand an earthquake as a single unit.

All structural elements must be securely tied together . The shaking and lateral forces of an earthquake will attack and separate building components at their weakest points. The foundation must act

as a single unit; the structure must be tied to the foundation to keep it from sliding; and the studs in the exterior walls must be tied together to reduce deflection and provide strength. The floors, roof, and interior walls must be tied securely to the walls to act as diaphragms and lateral supports. Almost all existing structures can be strengthened to be more earthquake resistant (not earthquake proof).



YOU HAVE A CHOICE

Our investigators have found that structural damage in earthquakes is most severe in two types of structures: those erected before the use of earthquake building codes and those poorly designed and/or constructed.

There is a 70% chance that you and your family will be at home during the next earthquake. You have a choice to make on how well your home will perform.



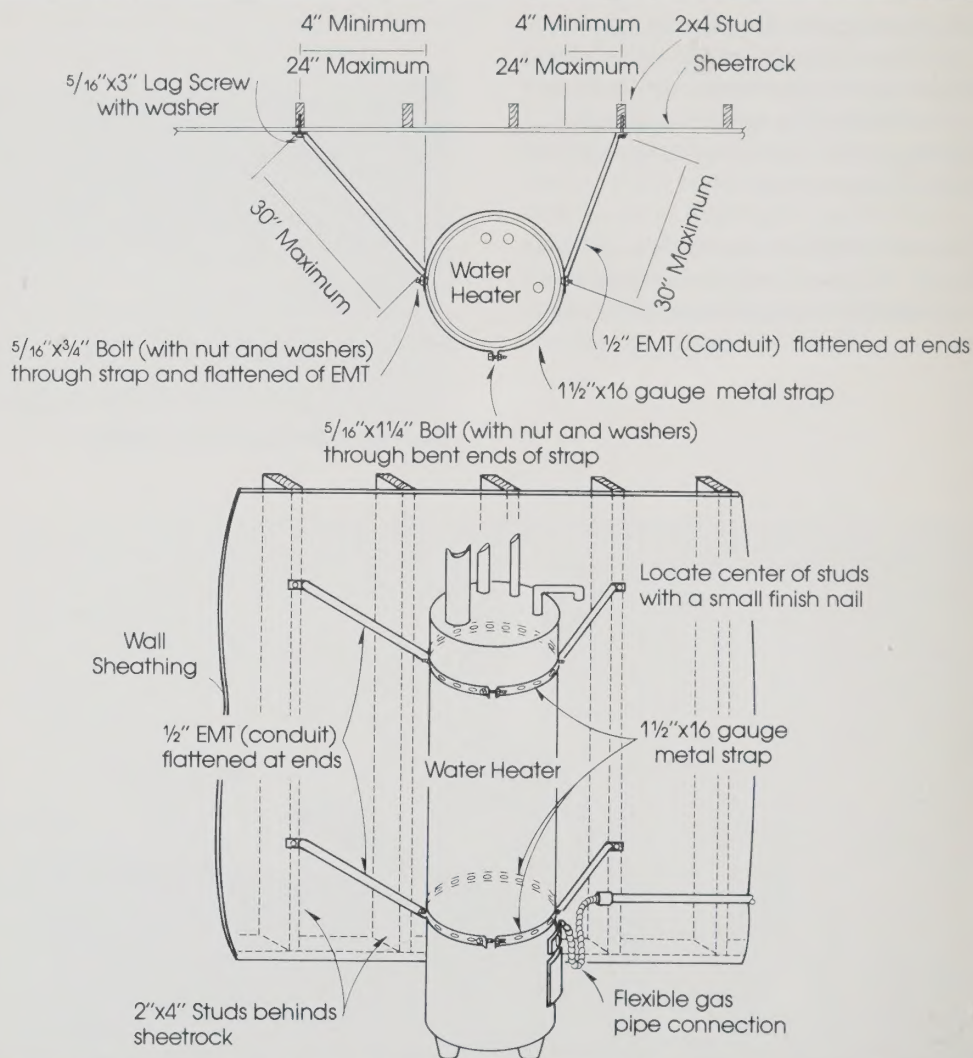
San Fernando (6.6 Richter Scale)



Coalinga (6.7 Richter Scale)

Earthquakes of a similar magnitude can cause very different levels of damage depending on the design and construction of homes.

PROJECTS EVERYONE SHOULD DO



MATERIALS NEEDED

- (2) 6' lengths of 1-1/2" 16 gauge pre-drilled strap
- (1) 10' length 1/2" EMT tube (conduit)
- (4) 5/16" x 3" lag screws with washers
- (4) 5/16" x 3/4" long hex head machine bolts with 4 nuts and 8 washers
- (2) 5/16" x 1-1/4" hex head machine bolt with 1 nut and 2 washers each

TOOLS NEEDED

- | | |
|-----------------|-----------------|
| Tape Measure | Power Drill |
| Hammer | 3/8" Drill Bit |
| Hack Saw | 3/16" Drill Bit |
| Crescent Wrench | Center Punch |
| Vise or Clamp | |

STRAPPING YOUR WATER HEATER

PROJECT



1 Strapping your water heater and making sure it is fitted with a flexible gas supply line will greatly reduce the danger of fire or explosion from a gas leak after an earthquake. If your water heater does not have a flexible gas supply line, contact a licensed plumber to install one. *These instructions are for a 30-40 gallon water heater within 12" of a stud wall.*

2 Mark water heater at 6" down from top and about 18" up from bottom. Transfer these marks to wall. Locate the studs in the wall on both sides of the water heater.

3 Drill a 3/16" hole 3" deep through the wall sheathing and into the center of the wood studs at the four marks made in step 2.

4 Measure around the water heater and add 2" to the measurement. Using a hacksaw, cut the two 1-1/2" x 16 gauge metal straps to this length for encompassing water heater.

5 Mark 1-1/2" from each end and insert in a vise or under a heavy object and bend the ends outward to approximately a right angle. Bend the straps into a curve.

6 Measure the distance from a point midway on each side of the water heater to the holes drilled in the wall. (Probably two different lengths.) Add 1-1/2" to these measurements. Using a hacksaw, cut two pieces of conduit to each of these two lengths.

7 Using a hammer, flatten approximately 1-1/2" at each end of the four pieces of tubing by laying the tube on a flat metal or concrete surface and striking with the hammer. Be sure you flatten both ends on the same plane.

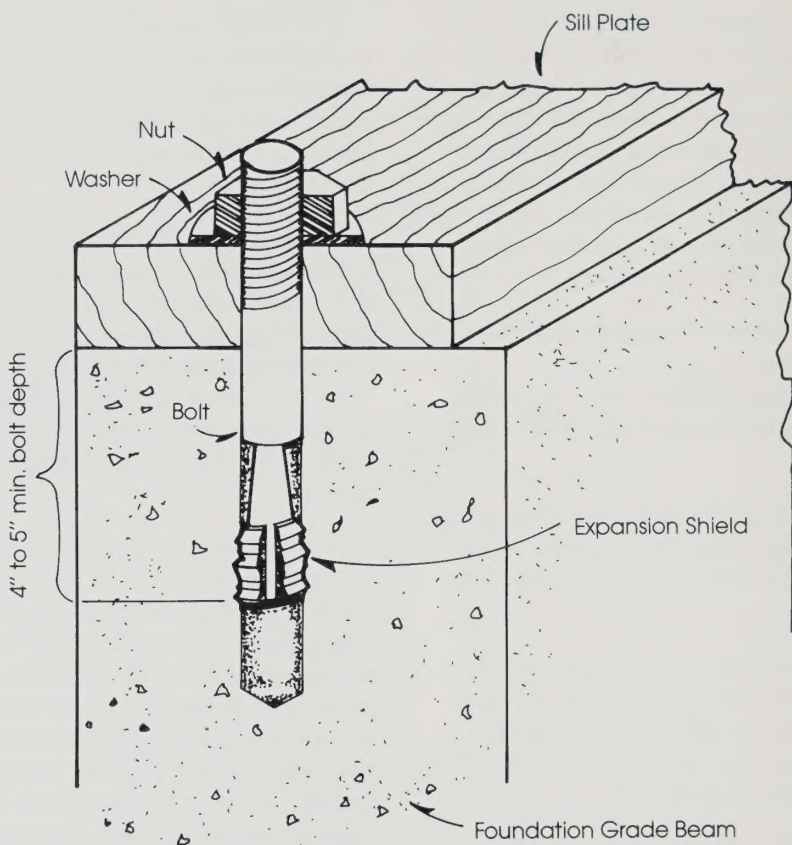
8 Insert the flattened ends of the tubes, one at a time, into a vise or clamp. With the hammer and center punch make a mark 3/4" from each end at the center of the flattened area of the tube. Drill 3/8" holes in the ends of all four tubes (8 holes). Be sure tubes are clamped down while drilling. Bend each end to about 45 degrees.

9 Wrap the straps around the heater and insert a 5/16" x 1-1/4" bolt with washers into the bent ends. Tighten nuts with fingers. Insert 5/16" x 3/4" bolts through strap from the inside at the midpoint on each side of water heater. Attach one end of each tube strut to a protruding bolt, add a washer and nut, and tighten with fingers. Insert 5/16" lag screw in the opposite end of each tube strut and insert in hole in the wall stud. You may need to tap the lag screw gently into the hole to start it, then tighten with crescent wrench.

10 Adjust the straps to the proper height and tighten all nuts snugly, but not too tight.

NOTE: You may wish to install an insulation jacket if your water heater is in an unheated space.

Based on our experience, the projects in this guide are extremely cost-effective and practical. In past earthquakes we have observed that if these projects had been completed before the earthquake, much of the damage to the home would have been eliminated.



MATERIALS NEEDED

5/8" x 8-1/2" Expansion Bolts
with Nuts and Washers

TOOLS NEEDED

Rotary Hammer Drill
Chalk or Crayon
3/8" x 36" of Plastic Tubing or Hose
5/8" x 12" Carbide Drill Bit
Sledgehammer (with short handle)
Crescent Wrench

BOLTING SILL PLATE TO FOUNDATION

PROJECT 2

1 Using chalk or crayon, lay out and mark spots on the sill plate for drilling holes every 4 feet. Also mark spots for drilling holes 6" to 12" from the end of any splice or step in the sill plate.

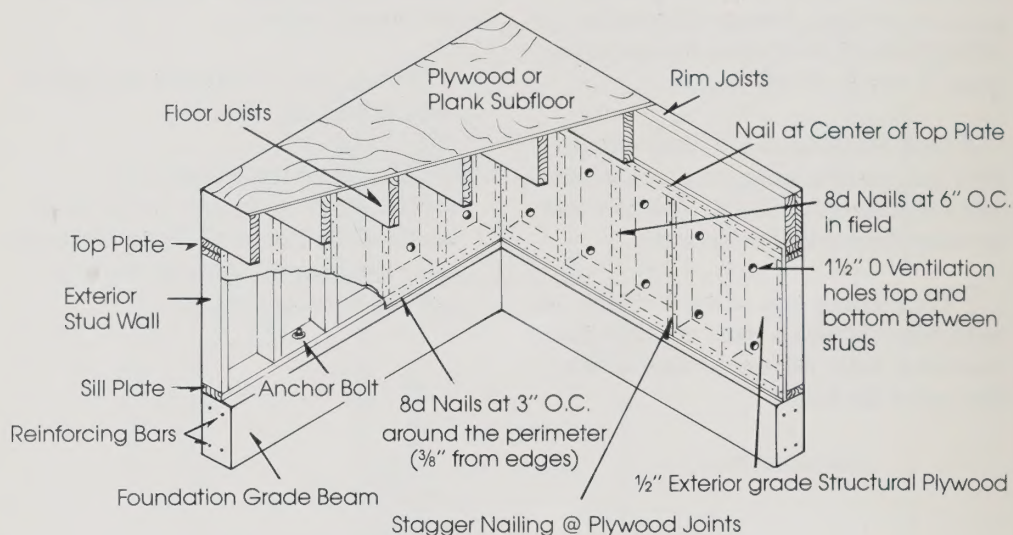
2 Drill 5/8" holes 8-1/2" deep into the plate and concrete using a rotary hammer drill with a carbide drill bit. This tool may be rented from a tool rental store.

3 Clear drilled hole of any concrete dust by blowing out with a piece of plastic tubing inserted in hole. Be sure to blow all the dust out of the hole.

4 Insert expansion bolt with nut and washer in place and drive into the hole with sledgehammer.

5 Once bolt is bottomed out, tighten nut down firmly.

NOTE: These instructions and specifications are for one- or two-story homes which have a minimum clearance of no less than 20" between sill plate and sub-flooring material.



MATERIALS NEEDED

1/2" STRUCTURAL I or C-DX plywood
 8d Common or Sinker Nails
 16d Common or Sinker Nails

TOOLS NEEDED

Circular Saw
 Jig Saw
 1-1/2" Hole Saw
 Framing Square
 Hammer
 Tape Measure
 Chalk Line
 Pencil

SHEATHING OF CRIPPLE WALLS

PROJECT

3

1 Check the sill plate to be sure it has been adequately bolted to the foundation.

2 Check to be sure the sill plate and studs are the same dimensions (flush at face). If not, block between the studs and nail the blocks into the sill plate with six 16d nails per block to create a flush nailing surface for the plywood.

3 Measure the distance between the bottom of the sill plate and the top of the top plate. Measure the distance between the corner stud and the middle of a stud at 4' or 8' away to be sure a standard sheet will fit; if not, two sides of the 4' x 8' sheet will need to be cut. Check that the studs are square with framing square and use it to lay out cuts on the plywood.

4 Mark the center line of the vertical studs on foundation and above cripple wall to locate studs behind plywood for later nailing.

5 Locate all exterior ventilation grates with respect to some easy reference point so that they will not be covered with plywood.

6 Cut the plywood with a circular saw using a plywood blade.

7 Place each pre-cut section of plywood up to check fit. It may need to be trimmed; a jig saw can be used to trim the plywood without taking it out of the crawl space.

8 Tack the plywood up temporarily with a few nails. Using chalk line, snap a line on the plywood between the marks made in Step 4. Nail the plywood to studs and plates with 8d nails. The nails should be spaced 3" apart around the entire perimeter of each plywood panel and 6" apart in the middle of each sheet.

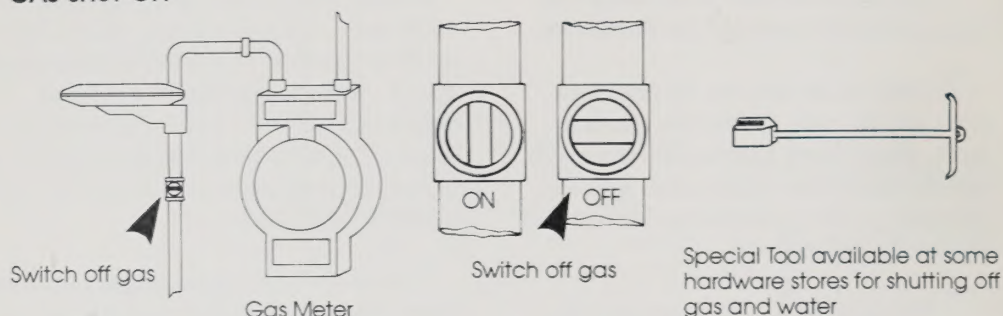
9 Measure and cut out a space with the same dimensions as the ventilation grates previously located using the jig saw.

10 Using a hole saw, drill two 1-1/2" ventilation holes for each cavity between studs. The holes should be 2" up from the sill plate, 2" down from the top plate and centered between the studs.

11 Measure the next section to be cut and fit only after the previous section has been completely attached.

NOTE: In most single-story houses, it would not be necessary to sheath the entire cripple wall area. However, since this is a homeowner project, it would be less expensive to do the extra sheathing than to hire an engineer to advise you which areas should be sheathed.

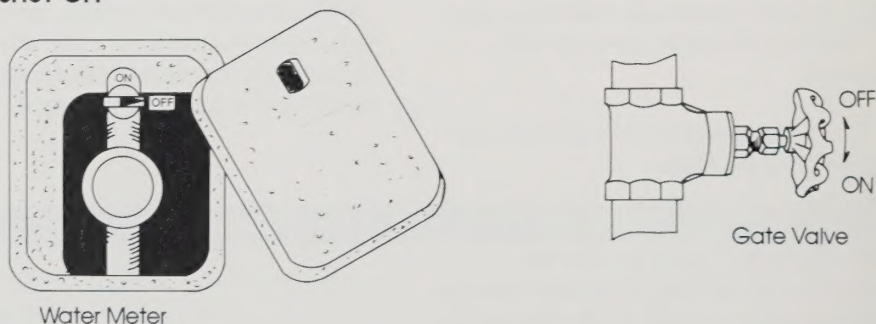
GAS SHUT-OFF



ELECTRICAL SHUT-OFF



WATER SHUT-OFF



MATERIALS NEEDED

White or Fluorescent Paint

TOOLS NEEDED

Crescent Wrench
Long Screw Driver or Specialty Tool for Gas and Water

GAS SHUT-OFF

- 1 Locate main gas shut-off (usually outside house) and all pilot lights.
- 2 Clear the area around the shut-off valve for quick and easy access in case of emergency.
- 3 A wrench (or specialty tool for turning off gas and water) should be attached to a pipe next to the shut-off valve or in another easily accessible, but hidden location.
- 4 You may want to paint the shut-off

valve with white or fluorescent paint so that it can be located easily in an emergency.

5 If you are concerned about your ability to turn off the main gas shut-off valve or are unsure if it is in proper working order (indication of rust, etc.) or do not know how to re-light your pilot lights, contact your local gas company. They can send a service representative to your house to show you the proper procedure and check the valve and pilot lights to be sure they operate properly.

ELECTRICAL SHUT-OFF

- 1 Locate main electrical shut-off.
- 2 Your house may be equipped with fuses or circuit breakers. If your house has fuses, you will find a knife switch handle that should be marked "MAIN." If your house has circuit breakers, you may need to open the metal door of the breaker box to reveal the circuit breakers (never remove the metal cover). The main circuit

breakers should be clearly marked showing on and off positions. If you have any sub-panels adjacent to the main fuse or breaker panel or in other parts of the house, be safe and shut them off too in an emergency.

NOTE: All responsible family members should be shown how to turn off utilities in case of emergency.

WATER SHUT-OFF

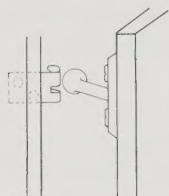
- 1 Locate the main water service pipe into your house (probably in the front at the basement level). You will see a gate valve on the pipe. If you know you have leaks after an earthquake, you can shut off all water in your house with this valve. You may wish to paint the valve so it is easy to find in an emergency.

2 You can shut off all water to your property by finding the water meter box (usually at the street or sidewalk). Open the cover with a long screwdriver or specialty tool. The valve can be operated by a special tool or with a crescent wrench. If this box is inaccessible or you cannot find it, call your local water department.

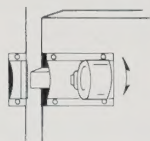
CABINETS



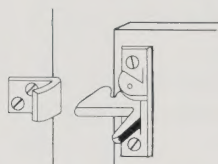
Hook and Eye
(Suitable for Garage Cabinets)



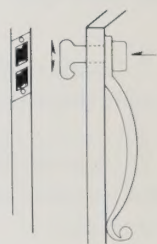
Childproof
(Out of sight, inexpensive,
easy to install)



Decorative
(Turn knob
to open)

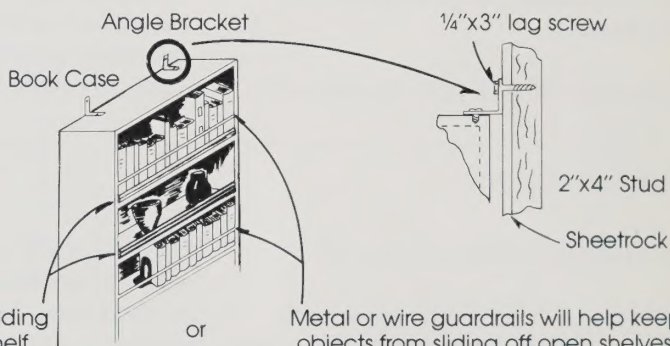


Decorative
(Pull back handle
to open)

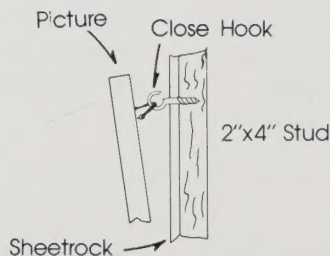


Decorative
(Release button
in handle)

TALL FURNITURE OR OPEN SHELVES



HANGING PICTURES



MATERIALS NEEDED

Cabinet Latches	Wood Trim
"L" Brackets	Small Nails or Brads
Lag Screws	Screw Hooks
Flat Head Screws	

TOOLS NEEDED

Screwdriver
Hammer
Pliers
Crescent Wrench

REDUCING INTERIOR DAMAGE

PROJECT

5

CABINETS

Install positive catching latches. Many variations are available at hardware stores.

TALL FURNITURE

Install metal "L" brackets between furniture and wall stud at top. (The "L" bracket can be installed inverted so it will be hidden from view.)

OPEN SHELVES

Install guard across shelf, or install wood trim on front of shelf. Place heavy objects on lower shelves.

HANGING PICTURES

Screw hooks into wood members only (stud or ceiling joints). Close hooks used for hanging pictures to prevent their falling.

PREPAREDNESS PLANNING

Be prepared -- what you do immediately following an earthquake may prevent injuries and significant financial loss.

Preparing for an earthquake takes two forms -- physical preparation (equipment and supplies) and mental preparation (knowing what to do).

We believe that the average home, with a few simple additions, has the supplies and food on hand to last up to 72 hours. State and local officials advise residents that outside help after a large, damaging earthquake may take up to 72 hours.

Based on our experience, if you live in an urban area, you should expect help within 24 hours following an earthquake.

However, **immediately following an earthquake** help from local fire and police departments will not be available. Be prepared to administer first aid or put out a small fire. Listed below are a few suggestions and hints on how to best utilize the resources at hand.

- *Water.* The water heater (30-40 gallons) for a family of four should contain enough water to last 4 days. The toilet tank can provide up to 7 gallons of water. Ice cubes in the freezer and liquid from canned food can be used. We recommend keeping purification tablets on hand rather than trying to store extra water.
- *Food.* Most houses have ample food on hand for several days. Use food in your refrigerator and freezer first. If there is no power, frozen food will keep 3 days in an unopened freezer.
- *First Aid.* Most homes have the necessary items to handle routine accidents. A first aid kit and a book on first aid should be kept in a central location. We recommend taking a first aid and CPR course from the Red Cross.
- *Fire Extinguishers.* Have one or more fire extinguishers. Learn how to use them! Have your fire extinguisher serviced annually to be sure it is working properly.

DEVELOP A FAMILY PLAN

Develop a plan for your family to use during an earthquake. Discuss it fully and conduct a drill. Draw a floor plan of your house and locate the following:

- ☐ Safest places in the house
- ☐ Most dangerous places
- ☐ Exits and alternative exits
- ☐ Utility shut-off valves
- ☐ Flashlights and batteries
- ☐ First aid kit
- ☐ Fire extinguishers
- ☐ Food and water supplies
- ☐ Batteries and transistor radio

You should also:

- ☐ Make special provisions for elderly or disabled family members.
- ☐ Make evacuation plans for your children's school or day care.
- ☐ Identify resources in your neighborhood. Find someone in your neighborhood to watch out for your house. Know the skills of your neighbors (doctor, engineer, etc.).
- ☐ Identify a person outside the immediate area to coordinate family contact. While local lines may be down, long distance lines will function sooner.
- ☐ Make special provisions for pets. Pets will not be allowed in shelters and will need to be confined in a safe room in your house.

EARTHQUAKE INSURANCE

Earthquake insurance should be purchased by those homeowners who cannot afford to lose a major portion of their largest asset -- the equity in their home. Most of us have a source of funds for repairing minor damage to our homes. But what if a loss of \$25,000 or more occurs from an earthquake? Many homeowners would feel the financial pinch. The most intelligent approach to considering earthquake insurance, as with other kinds of insurance, is to buy coverage only when the lack of it will create a financial burden. In short, it is necessary first to decide at what level of loss -- \$25,000, \$50,000, \$100,000 -- the repair or rebuilding of your home becomes an unacceptable burden. This is an individual financial question, but we can look at a hypothetical case to help in making this judgment.

LET'S ASSUME . . .

1. That the cost of replacing your home, the Replacement Cost Value or RCV, is \$130,000.
2. Now let's assume that a major earthquake (8+ on the Richter Scale) occurs in your area and your home is damaged to the extent of either 10% of the RCV or, on the other extreme, totally destroyed. The dollar loss would be either \$13,000 or \$130,000 **in terms of structure only.**

3. Valuable contents of your home may be damaged or destroyed, including furniture, fixtures, and appliances. This cost can be estimated as a percent of the house damage, say 20% or between \$2,600 and \$26,000 with total destruction.
4. Consider that there will be some dislocation of your family while the home is rebuilt. This could range from two weeks for minor damage to six months for a totally destroyed home (particularly when contractors will be in great demand). At an average weekly cost of \$500, for example, this cost could be \$1,000 or \$12,500.

LET'S ALSO ASSUME . . .

- You have \$150,000 in equity in your home, and your furniture and personal possessions, including two cars, are valued at \$35,000.
- You have a money market account with \$12,000, two IRAs worth \$10,000, and securities valued at \$25,000.

In total, your liquid assets (excluding pension fund and social security interests) amount to \$232,000.

HOW MUCH IS ENOUGH?

A generally accepted rule of thumb is that you should not risk more than 10% of your liquid assets, or about \$23,000 in our hypothetical case.

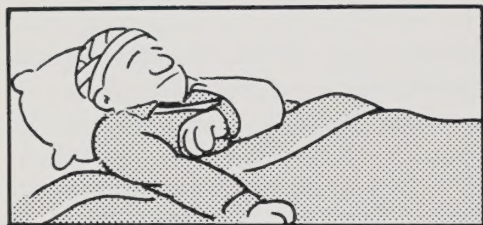
Adding up our earthquake damage costs in both the minor and major damage scenarios, we find

	<u>MINOR DAMAGE</u>	<u>DESTRUCTION</u>
Structure	\$13,000	\$130,000
Contents	2,600	26,000
Living Expense	<u>1,000</u>	<u>12,500</u>
Estimated Total	\$16,600	\$168,500

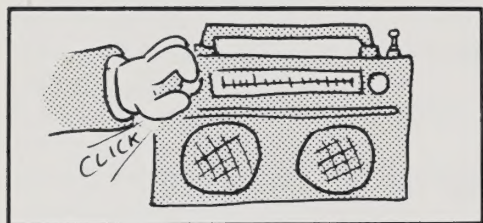
The conclusion that can be drawn in our hypothetical case is that minor earthquake damage can be assumed without insurance coverage, but the potential damage from a major earthquake far exceeds safe financial guidelines. This in turn suggests that most homeowners should have earthquake coverage. The coverage should recognize the ability of the homeowner to assume some of the loss, up to \$23,000 in our example, in return for lower-priced catastrophe coverage that meets the critical financial need.

Most earthquake insurance coverage in California is offered as part of the basic Homeowners insurance policy and usually involves a deductible of 10% of total replacement value. Also, there are plans that provide catastrophe coverage priced to specifically recognize the particular risk involved (exact location, soil conditions, type of structure, etc.). We suggest that you analyze your specific needs along the lines suggested above and then consider the quality and cost effectiveness of the alternatives.

AFTER AN EARTHQUAKE



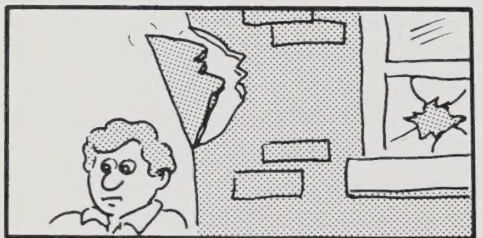
Check for injuries, give first aid, and cover the seriously injured with blankets to prevent shock. Do not attempt to move seriously injured persons unless they are in immediate danger.



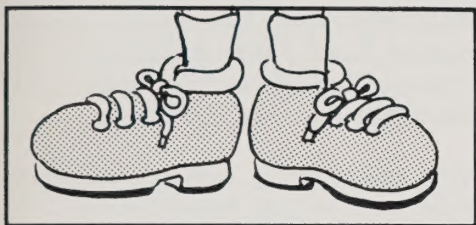
Turn on a battery-operated or car radio and listen for information on what to do.



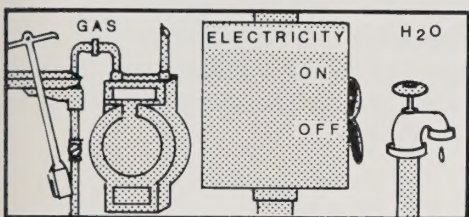
Do not attempt to drive anywhere. Roads may be damaged or blocked with debris. Freeway overpasses may be down. Use will be restricted to emergency vehicles only.



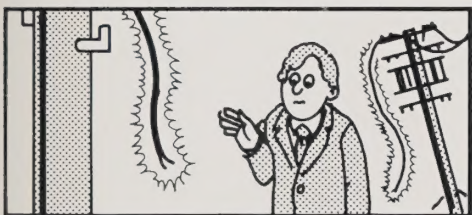
Plan for strong aftershocks. Stay out of already weakened and damaged homes.



Wear shoes to protect your feet from broken glass and debris.



Don't take unnecessary risks. If you notice any damage, turn off gas, electricity, and water. Do not turn back on until each has been properly inspected.



Do not touch downed power lines or objects in contact with power lines.



Do not expect the telephone to work. Do not try to use the telephone unless it is an extreme emergency.

ADDITIONAL RESOURCES

**FOR INFORMATION ON FIRST AID
AND CPR:** Red Cross

**FOR CLASSROOM TEACHING
PROGRAMS:** Environmental Volunteers,
Palo Alto (415) 327-6017

California Earthquake Education Project
(CALEEP)
Lawrence Hall of Science, University of
California, Berkeley (415) 642-8718

FOR LOCAL FAULT MAPS: State of
California, Division of Mines & Geology
(Regional Office)

**FOR ADDITIONAL INFORMATION ON
YOUR COMMUNITY'S EMERGENCY
PLANS:** The Southern California
Earthquake Preparedness Project
(SCEPP)

Bay Area Regional Earthquake
Preparedness Project (BAREPP)

Offices of Emergency Services (City and
County)

**FOR ADDITIONAL INFORMATION ON
EARTHQUAKES:** Book by Peter Yanev
entitled, *Peace of Mind in Earthquake
Country*, Chronicle Books, 870 Market
Street, San Francisco, CA 94102

**FOR ADDITIONAL INFORMATION ON
PSYCHOLOGICAL IMPACTS OF
EARTHQUAKES:** Book by Stephen J.
Howard entitled, *Mental Health
Intervention in a Major Disaster* (available
from San Fernando Valley Child Guidance
Clinic, 9650 Zelzah Avenue, Northridge,
CA 91325)

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BAREPP



**BAY AREA REGIONAL
EARTHQUAKE PREPAREDNESS
PROJECT**

METROCENTER
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